Vaccination of dams to optimize passive immunity in calves, does it provide any clinical advantages?

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Justification

- Maternal colostrum provides **variable levels** of specific immunity against respiratory and enteric pathogens
  - Reduction of overall herd immunity
  - Increase risk of introduction and spread of infectious agents
- Increasing pathogen-specific passive immunity
  - > uniformity of herd immunity against specific pathogens
  - > duration of maternal immunity
  - Significant reduction of clinical disease?

Windeyer et al., Am J Vet Res 2015;76:239

- **76 heifer calves** from **5 dairies** with BRD issues (US and Canada)
- Initial serum antibodies compared between calves treated or not for BRD
  - weeks 1 through 12 (~3 months)
- 21 % of the risk of BRD attributed to FTPI
- Low **(< 256**) initial **BRSV** antibody **titer**
  - **32% greater risk** of being treated for BRD
- Maternal immunity important for BRD prevention

Principles of dam vaccination

- Documented need in the herd (i.e., *E.coli* K99, BRoV, BRSV, etc.)
  - Calf diarrhea
  - BRD in pre-weaned calves
- Adverse reactions in pregnant cows!
  - > 3 gram negative bacterins at the same time (endotoxin stacking)
  - Abortion and/or anaphylaxis
- Inactivated vaccines
  - 2 doses 21 days apart before calving
- Adequate management is critical
  - Environmental – calving pen/pasture

Field trials - Vaccination of dams against BRoV, BCoV, and *E.coli* K99

Loucks et al., J Dairy Sci 1985; 68:1841

- Dairy cows vaccinated with 2 doses of an *E.coli* K99 bacterin. Calves fed colostrum from their dams.

Group	Mean K99 AB in colostrum	Mean K99 AB in serum of calves	STP of calves at 24h (g/dL)	Pre-weaning mortality
2 doses	3403.6	406.4	6.2	7.1%*
1 dose	1637.7	149.4	6.3	11.1%
Control	73.7	14.5	6.5	10.6%

Snodgrass et al., Vet Rec 1986

- Combination of BRoV, BCoV, *E. coli* K99 vaccine
- 40 herds
  - 31 herds with no history of diarrhea and < 10% morbidity: No effect
  - 9 herds > 10% diarrhea
    - 4/9 herds *C. parvum* diarrhea
    - 1/9 herds no pathogen isolated
    - 2/9 beef herds (n=105 cows) reduction of BRoV shedding but no effect on clinical disease
    - 2/9 dairy herds (n=68 cows) reduction of clinical disease

Meganck et al., Prev Vet Med 2015; 118:64

- 24 Belgium dairy herds with high prevalence (>10%) of diarrhea in calves
- 13 herds vaccinated cows with 2 doses BRoV, BCoV, K99 vaccine + Halofuginone treatment for calves at birth
- 11 herds unvaccinated controls
- Natural occurrence of diarrhea in calves
  - 14.3% Vacc + Halofuginone
  - 39.7% control
- Unclear if it was the halofuginone or vaccine!

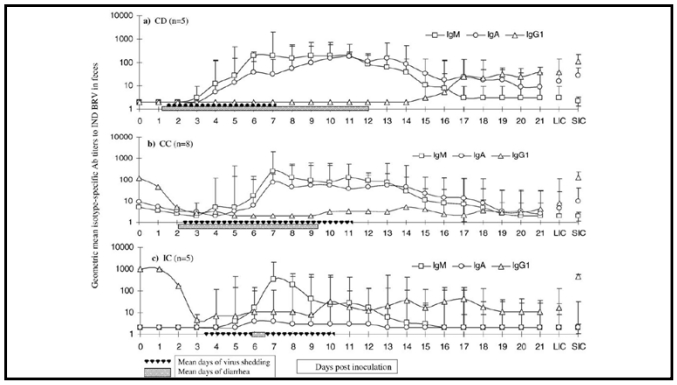
Mawling et al., Vet J 2015; 203:155

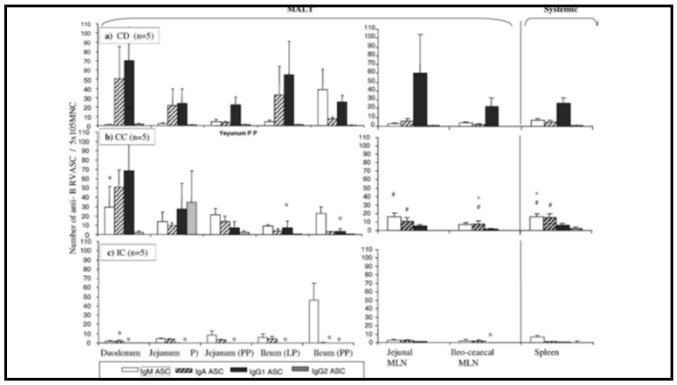
- Evaluated risk and protective factors for calf diarrhea in 97 NZ dairy herds with history of calf enteric disease due BRoV, BCoV, *E. coli* K99, *Salmonella* spp., and *Cryptosporidium parvum*
- The odds of diarrhea in calves were **3.3 greater** in herds that **DID NOT vaccinate** cows with multivalent (BRoV, BCoV, *E. coli* K99) vaccines before calving compared with herds that vaccinated

Parreno et al., Vet Immunol Immunopahtol 2004; 100: 7-24 – exposure too early

- 18 Dairy calves
  - CD (n=5): no colostrum
  - CC (n=8): 1 L of colostrum from unvaccinated cows within 6h
  - IC (n=5): 1 L of colostrum from BRoV vaccinated cows within 6h
- Challenged with BRoV at 2 days of age
  - Euthanized 21 d – intestinal tissue evaluated
- Morbidity as well as systemic and local (intestinal) B cell responses evaluated
  - Mortality not evaluated

Treatment groups	*n*	IgG1 Ab GMT against BRV IND at inoculation	
		Serum	Feces
Colostrum-deprived (CD), IgG1 < 4, VN < 4	5	<4 C[d]	<4 C
Control colostrum (CC), IgG1 = 16384, VN = 65536	8	1024 B (1577)	117 B (1394)
Immune colostrum (IC), IgG1 = 262144, VN = 1048576	5	28526 A (26922)	1024 A (1988)





- Delay in onset and duration of diarrhea associated with colostral IgG-1
  - Shorter (0.8 d) in IC calves vs. CC (7 d) and CD (11 d) calves
- CD calves faster and greater IgA response
  - Activation of B cell response after challenge
  - But got sick!
- Lower IgG-1 and IgA plasma cells locally (PP's) in IC calves
  - No activation of B cell response
  - But did not get sick!

- Ideally vaccinating at a mid point when colostral immunity may provide clinical protection and allow good activation of adaptive immunity!!
  - Tricky

Vaccination of dams against *Salmonella* spp.

Smith et al., J Vet Int Med 2014; 28:1652

- Dairy cows vaccinated with 2 doses of a *Salmonella e*. Newport extract (SRP). Calves fed colostrum from their dams

Group	Mean ELISA AB serum dams	Mean ELISA AB colostrum	Mean ELISA AB calves 24h
Vaccinated	0.69	1.49	1.04
Control	0.16	0.66	0.3

Smith et al., J Dairy Sci 2015; 98:2559

- Dairy cows vaccinated with a modified-live *Salmonella e*. Dublin vaccine. Calves fed colostrum from their dams.

Group	Mean ELISA AB serum dams	Mean ELISA AB colostrum	Mean ELISA AB calves 24h
Vaccinated	17.2	40.3	88.5
Control	14.8	-9.4	-3.2

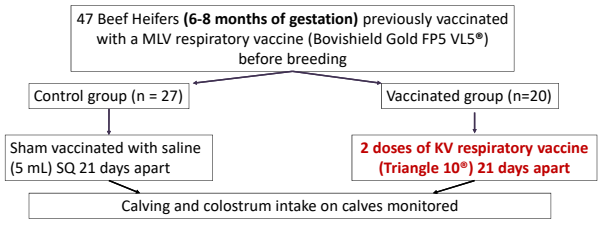
Vaccination of dams against BVDV, BHV-1, BRSV, and *Mannheimia haemolytica*

Smith B, et al., Am J Vet Res 2015

- Holstein cows vaccinated with 2 doses KV multivalent vaccine at dry off/close up

		Mean AB titers - Serum calving		Mean AB titers – Colostrum	
Virus	**Parity**	**Control**	**Vaccinated**	**Control**	**Vaccinated**
BHV-1	1	64	256	40	1,280
	2+	128	512	240	1,280
BVDV 1	1	128	64	640	10,240
	2+	96	128	840	10,240
BVDV 2	1	64	384	2560	20,480
	2+	192	2,566	12,800	20,480

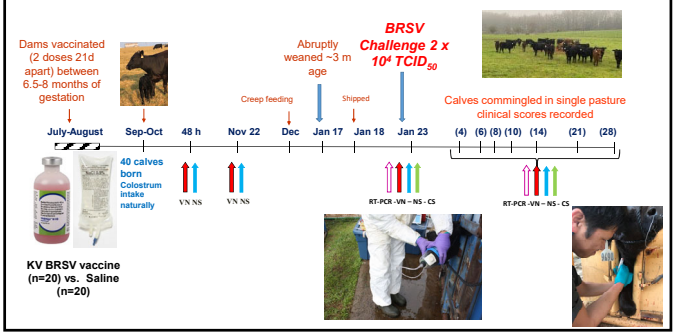
Reppert EJ et al., Can Vet J 2019

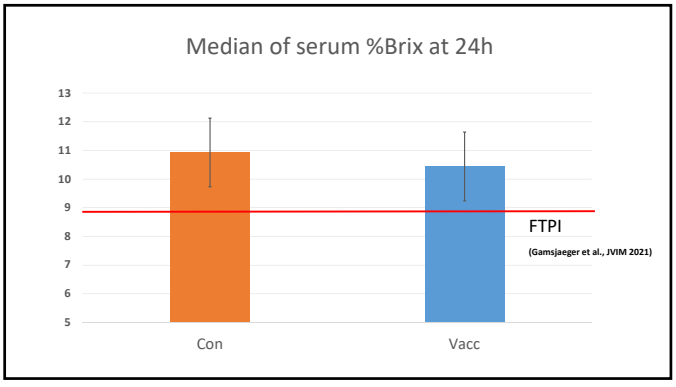


SERUM IgG (g/L) and antibody titers to respiratory viruses **in calves**

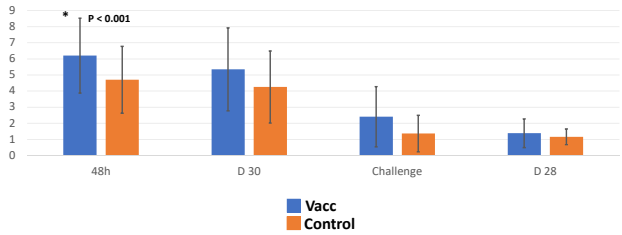
Outcome	Treatment group	Mean	P-value
IgG	Vacc.	30.18	0.265
	Control	32.28	
IBR	Vacv.	7.05	<0.001
	Control	4.37	
BVDV-1	Vacc.	8.90	0.009
	Control	7.26	
BVDV-2	Vacc.	8.90	0.071
	Control	7.96	

Martinez et al., *Am J Vet Res* 2022; 83:1

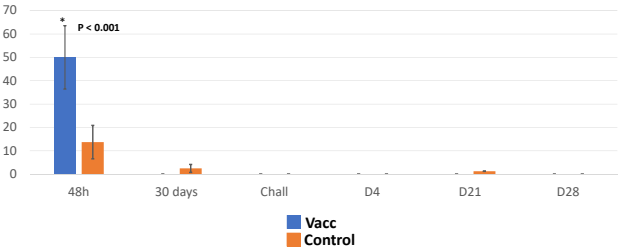




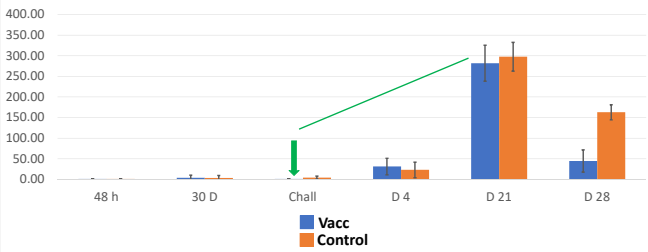
Mean Log2 BRSV SNA titers +/- SD

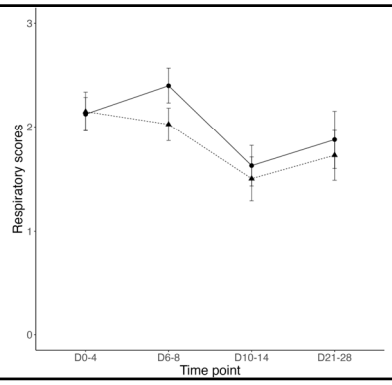


Mean nasal BRSV-IgG-1 titers +/- SD



Mean nasal BRSV-IgA titers +/- SD





Score	BRD
1-5	Mild
5-10	Moderate
> 10	Severe

Prado et al., Vet Immunol Immonopathol 2006; 111:301

- *M. haemolytica* LKT, WC, and P. *multocida* OMPs serum antibodies were evaluated in beef calves born to cows vaccinated (2 doses of Presponse-HM®) or not prior to their 1st breeding
  - Rapid (30 days) decay of serum IgG-1 to *Mh* LKT and WC and *Pm* OMPs in calves from control cows
  - Prolonged duration of serum IgG-1 to *Mh* LKT and WC and *Pm* OMPs in calves from vaccinated cows

Take home

- Maternal colostrum is essential for calf survival during first weeks
  - Provides clinical protection
  - High specific serum antibody titers at the time of exposure reduces clinical disease
    - BVDV, BHV-1, BRSV, BRoV
  - Short persistency of IgG-1 from colostrum in mucosal surfaces may result in short-duration clinical protection (diarrhea, BRD)
    - Specific IgG-1 from colostrum gone when exposure occurs or when risk is greater
- When controlling for other risk factors (environment, biosecurity)
  - Vaccination of dams may reduce infectious disease in calves

Questions?

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